Re-specifying Acceptable Biological Catches for the Coral Reef Species of Concern in the Western Pacific Region

116th Meeting of the Scientific and Statistical Committee
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The SSC's Task

At its 116th meeting, the SSC will be reviewing the ABC for the coral reef species of concern. The initial round of specification was good for 2 years (2012 and 2013). At the 113rd SSC Meeting in 2013, the SSC adopted the same ABC for the humphead wrasse (*Cheilinus undulatus*), bumphead parrotfish (*Bolbometopon muricatum*), and reef sharks (Carcharhinidae). Since catch data was not available for these species, except for sharks, the SSC could not apply the Tier 5 method and utilized a proxy method of ABC = 5% of expanded biomass.

For the reef sharks the biomass augmented catch-MSY approach was used to determine the MSY (Sabater and Kleiber 2014). The biomass data was derived from the underwater census surveys of CRED which was expanded by the hard bottom habitat (Williams 2010). The P* working group already evaluated and scored the assessment aspect and the uncertainty characterization of the biomass augmented catch-MSY model. The SSC needs to determine the appropriate stock status determination as well as the Productivity and Susceptibility Scores and derive the P* level from which the ABC will be based upon.

For humphead wrasse and bumphead parrotfish, there are no new information available to could adjust the current ACLs. There are no catch data to support new methods in specifying ABCs.

It is projected that there will be no significant new information that would be available for the coral reef species of concern in the next 4 years hence for a multiyear ABC and ACL specification can be considered for fishing year 2015-2018.

Current catch information

Bumphead parrotfish and humphead wrasse does not exist in Hawaii. There were no catches of bumphead parrotfish in the Territories. Humphead wrasse catch was recorded in Guam at 319 lbs out of an ACL of 1,960 lbs. There were no catch record of humphead wrasse in American Samoa and CNMI. Reef shark catches were recorded in Guam and Hawaii at 12 lbs and 2,512 lbs, respectively.

Summary of options

The table below shows the summary of options for the SSC:

Table 1. Options for the SSC to consider when specifying ABC for the coral reef species of concern for fishing year 2015-2018.

Management Unit Species	Most recent catch (2013) (lbs)	Option 1: Status quo/Roll over current ABCs (lbs)	Option 2: Adopt re-calculated ABCs using model-based approach (lbs)
Bumphead parrotfish			
• Hawaii	N/A	N/A	N/A
• American Samoa	0	235	235 (no new info)
• CNMI	0	797 (GU&CNMI)	797 (GU&CNMI)
• Guam	0		
Humphead wrasse			
• Hawaii	N/A	N/A	N/A
• American Samoa	0	1,743	1,743 (no new info)
• CNMI	0	2,009	2,009 (no new info)
• Guam	319	1,960	1,960 (no new info)
Reef sharks			
• Hawaii	2,512	111,566	9,800
• American Samoa	0	1,309	1,700
• CNMI	0	5,600	5,600 (no catch data)
• Guam	12	6,942	2,000

Background Information

For species of special management interest (bumphead parrotfish, humphead or Napoleon wrasse, and reef sharks), the SSC at its 108th meeting noted that these species occur infrequently in NOAA CRED RAMP surveys and have low overall catch. Therefore, data paucity precludes the utility of the Tier 5 control rule. For reef sharks and humphead wrasse, the SSC recommended setting ABC for each taxa at five percent of the biomass estimated by NOAA PIFSC CRED tow-board diver surveys. However, for bumphead parrotfish, only density data is available and limited to Pagan Island, CNMI (1.61 individuals/per km²), and the American Samoa islands of Tau (1.08 individual/per km²) and Tutuila (0.41 individuals/per km²) (NMFS unpublished data). Density estimates for each archipelago were converted to hectares (ha) and expanded based on total area of hard bottom habitat between 0 and 30 m (Mariana Archipelago: 24,289 ha; American Samoa: 7,790 ha) as estimated by Williams (2010). Expanded densities were then converted to biomass in kg using the average length (94 cm) and the CRED allometric conversion factors (a_value: 0.0183; b_value: 3.0421). Biomass was then converted back to pounds and ABC was set to 5% of this estimated biomass. Table 2 lists the estimated stock biomass for reef sharks, humphead or Napoleon wrasse and bumphead parrotfish in American Samoa, Guam, the Northern Mariana Islands and Hawaii.

Table2. Estimated stock biomass (in lb) of reef sharks, humphead wrasse and bumphead parrotfish in all island areas

Island Area	Reef sharks		Humphead wrasse[1]		Bumphead parrotfish[1]	
	Biomass[2]	5% Biomass	Biomass[2]	5% Biomass	Biomass	5% Biomass
American Samoa	26,181	1,309	34,860	1,743	4,699	235
CNMI	111,997	5,600	40,184	2,009	15,931	797
Guam	138,830	6,942	39,200	1,960		
Hawaii	2,231,321	111,566	0	0	0	0

[1] *Bolbometopon muricatum* (bumphead parrotfish) and *Cheilinus undulatus* (humphead or Napoleon wrasse) do not naturally occur in Hawaii
[2] Estimated biomass data provided by NMFS, PIFSC, CRED (unpublished data)

Reef Sharks: HAWAII, AMERICAN SAMOA, GUAM

MSY was estimated for the reef sharks using the catch-MSY approach originally developed by Martell and Froese (2012) where it implemented a Monte-Carlo simulation to generate a biomass project using a range value of rate of population increase, *r*, and carrying capacity, *k*, minus the catch at any step in the time series. This approach was augmented by adding biomass information as one of the priors (Sabater and Kleiber 2014). The augmented approach is useful if there is a biomass estimate. In the absence of the biomass estimate, the model defaults to running the original routine as described by Martell and Froese (2014). Biomass values used for the analysis were from Williams 2010. The model approach was not used for CNMI because CNMI does not have a catch time series for sharks, hence the ABC for CNMI will remain the same in absence of no new information.

The following MSYs were generated for Hawaii, American Samoa, and Guam

Jurisdiction	MSY (lbs)	sigma	mode	5%	95%
Hawaii	12,400	600	12,500	4,300	34,700
Guam	2,900	700	2,900	1,000	8,900
CNMI	No catch data to support the model				
American Samoa	2,300	900	2,400	600	9,600

At the 115th SSC Meeting and the 159th Council Meeting, the SSC and Council, respectively, heard the presentation on the final results of the P* Analysis conducted by the P* Working Group. This analysis covered the first two dimensions of the P* analysis with a total of 8 point deduction to the 50% risk of exceeding MSY. In order to specify the ABC, the SSC must deliberate the score for the stock status using the following rules:

Description	Fishing level	Score
Lightly harvested	Catch << 1/3MSY	0.0
Moderately harvested	Catch < MSY	2.5
Fully harvested	Catch ≈ MSY	5.0
Over harvested	Catch > MSY	7.5
Severely Over harvested	Catch > 2x+MSY	10.0

Once applied, the following scores were derived:

Area	MSY	ACL	ave 3 yrs	1/3 MSY	2/3 MSY	2x MSY	3x MSY	0	2.5	5	7.5	10
Hawaii	12,400	111,566	2,467	4,133	8,267	24,800	37,200	0	F	F	F	F
Guam	2,900	6,942	1,062	967	1,933	5,800	8,700	F	2.5	F	F	F
American Samoa	2300	1309	33	767	1,533	4,600	6,900	0	F	F	F	F
CNMI	No catch information to support the model											

Exploitation level scores for reef sharks in Hawaii = 0
Exploitation level scores for reef sharks in American Samoa = 0
Exploitation level scores for reef sharks in Guam = 2.5

Regarding the productivity-susceptibility dimension, scores are given at 2.5 point reduction increment. A productivity score of 0 point reduction is given to stocks that are highly productive, 5 point reduction for medium productivity, and a score of 10 point reduction for low productivity stocks. For susceptibility, a score of 0 point reduction for stock that are not vulnerable or has high resilience, 5 point reduction for mid-level vulnerability, and a 10 point reduction score for species that are highly susceptible to overfishing or getting overfished. The PSAs are mostly based on the life history characteristics and the type of fishery the species are harvest.

The species in the reef shark complex pertains to the white tip, black tip, gray reef, and some minor shark species that intermittently show up in the catch records. Typically, reef sharks are considered slow growing. A study by Jack Randall published in Pacific Science[1] showed the white tip shark grows on average 4 cm per year for males and 2.3 cm for females based on tagging studies. Reef sharks are also live bearing animals that produce 4-5 offspring per birth. Of the 13 pregnant specimen gathered, each female had 1-5 embryo on average. Given this life history trait, productivity score can be a low productivity earning a **reduction score of 10**.

Ecological underwater surveys of CRED also showed that reef sharks are less abundant in areas near the population centers[2]. This could be due to interaction of the sharks life history traits with the impacts occurring in the areas near population centers. It is well known that sharks are

[1] Randall J.E. 1977. Contribution to the biology of the white tip reef shark (*Trienodon obesus*). Pacific Science 31(2): 143-164.
[2] Nadon, M. O., Baum, J. K., Williams, I. D., McPherson, J. M., Zgliczynski, B. J., Richards, B. L., ... & Brainard, R. E. (2012). Re-Creating Missing Population Baselines for Pacific Reef Sharks. Conservation Biology, 26(3), 493-503.

vulnerable to fishing impact through direct removal and may have an effect on ecosystem functions[3]. Some also assert that reef sharks are headed to ecological extinction[4]. However, commercial reef shark fisheries do not exist in the Western Pacific region. Very small amount of catch have been recorded. For years, the Marianas fishermen were also complaining about the high rate of shark depredation on their catches. In addition, local laws have been established to ban landing of sharks. Considering all these factors, the susceptibility score can be placed at medium with a **reduction score of 5**.

This would result in the following scores for the spiny lobster in the PSA dimension:

PSA scores for reef sharks in Hawaii = 7.5
PSA scores for reef sharks in American Samoa = 7.5
PSA scores for reef sharks in Guam = 7.5

Summing all the dimension scores results in the following P* values:

	Scientific Information	Uncertainty Characterization	Stock Status	PSA	Summ scores	P*
Hawaii	3	5	0	7.5	15.5	34.5 ≈ 35
American Samoa	3	5	0	7.5	15.5	34.5 ≈ 35
Guam	3	5	2.5	7.5	18	32 ≈ 30
CNMI	No catch data to support model approach					

The risk tables generated by the Catch-MSY approach shows the catch level associated with the respective risk levels corresponding to the ABC:

	P*	ABC (lbs)
Hawaii	34.5 ≈ 35	9,800
American Samoa	34.5 ≈ 35	1,700
Guam	32 ≈ 30	2,000
CNMI	No catch data available	

[3] Stevens, J. D., Bonfil, R., Dulvy, N. K., & Walker, P. A. (2000). The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems. ICES Journal of Marine Science: Journal du Conseil, 57(3), 476-494.
[4] Robbins, W. D., Hisano, M., Connolly, S. R., & Choat, J. H. (2006). Ongoing collapse of coral-reef shark populations. Current Biology, 16(23), 2314-2319.